



FOREST PEST MANAGEMENT

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BIOLOGICAL EVALUATION OF PESTS AT LOS PRIETOS RANGER STATION AND OAK DIEBACK, SANTA BARBARA RD, LOS PADRES NATIONAL FOREST

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ABSTRACT

A dead Monterey x knobcone pine behind the Los Prietos Ranger Station was infected by armillaria root disease and had been attacked by pine engraver beetles. The tree had been predisposed to root disease infection by sprinkler irrigation of the lawn beneath it. Decreasing this type of irrigation around the remaining trees will increase the probability that they will not be successfully attacked by the root disease. In the tree improvement site, Cuyamaca cypress were attacked by cypress bark beetles. Monterey x knobcone pine hybrids were attacked and killed by pine engraver beetles. Management alternatives for the control of pine engraver beetles are presented. Dieback of coast live oaks along the Santa Ynez River was caused by attacks of the Pacific oak twig girdler. This insect becomes important on southern California live oaks during periods of droughts. Little permanent damage is anticipated, although there will be visual concerns. No cost effective controls are known for the general forest, but deep watering and fertilization of specimen trees may increase their vigor sufficiently to reduce the number of attacks in the future, if the current drought continues.

INTRODUCTION/OBSERVATIONS

At the request of the Los Padres NF, we examined several pest situations on the Santa Barbara Ranger District. We were accompanied by John Bridgewater and Dawn Lipton from the District on August 19, 1985.

LOS PRIETOS RANGER STATION

The first situation we examined was at the Los Prietos Ranger Station. A large Monterey x knobcone pine hybrid (*Pinus radiata* x *attenuata*) had recently died in the yard behind the station. Several additional pines were in the immediate vicinity and their future health was of concern. Evidence of two pests was observed in the dead tree. Old galleries of pine engraver beetles

(Ips spp.) were seen under the bark of the bole. The insects had already matured and exited. We also found zone lines, indicative of armillaria root disease (Armillaria sp.), in the root wood.

This tree was surrounded by a large lawn that is sprinkler irrigated to maintain the grass. Surface irrigation of this type oftentimes results in increased susceptibility of native trees to armillaria root disease. This increased susceptibility may have been accentuated by the recent below normal precipitation and the lack of available subsurface water. Following invasion of the roots and progression of the fungus in the cambium, the pine engraver beetles were able to successfully attack and kill the tree.

Although this particular individual has died, actions can be taken to increase the likelihood of survival of the surrounding pines. As stated before, susceptibility to armillaria root disease increases in lawns irrigated by sprinklers. Continued sprinkling, especially with the presence of the large food base (the stump and root system of the dead pine) so near to live hosts, substantially increases the risk of their infection. Stopping irrigation within the drip line of the pines may reduce this risk. Because these trees have been receiving supplemental watering, it may be advisable to continue to provide additional water in the summer. This should be done by deep watering. Two to three waterings during the mid to late summer is appropriate depending on precipitation the previous winter and the onset of fall rains. Replacing the grass under the trees with some type of mulch would lessen any problems with dust that might develop after the grass dies.

Biology Of Armillaria Root Disease

Armillaria sp. is widely distributed in soils and usually lives as a saprophyte on dead wood or other organic matter. This fungus has a wide host range, including virtually all woody plants in California. It is frequently associated with hardwood roots, especially oaks. Healthy oaks are resistant to the fungus. This resistance disappears, however, when trees are weakened, stressed, cut, or killed, and Armillaria sp. may then rapidly colonize and decompose roots and sometimes entire root systems. Stresses that have been linked to increased damage from this root disease include insect defoliation, drought, excessive soil moisture, poor planting techniques, bark beetle attack, air pollution injury, and nutrient deficiencies.

The organic material used as a source of nutrition is called a food base. With a large food base to utilize, the fungus becomes more aggressive and moves to the roots of nearby trees by means of root contacts and rhizomorphs. Rhizomorphs are structures that resemble black shoestrings and grow like roots through upper soil layers. The predominant method of tree to tree spread in California is via root contact; rhizomorphs are more important and prevalent in other areas of the country.

Armillaria sp. is capable of directly penetrating through the intact root bark of living trees and once it reaches the cambium it usually grows rapidly, producing a flat, white, leathery, fan-shaped mycelial mat. Rhizomorphs are often associated with the mat. If the fungus reaches the root collar it girdles the stem and kills the tree. After Armillaria sp. successfully

colonizes a root segment or root system, it continues to decay the wood and causes a white to yellowish, wet, stringy rot. This rot does not usually extend more than a few feet above the soil line.

Clusters of mushrooms may be found in the fall at the base of infected dead or dying trees and stumps. These mushrooms may also grow directly out of the soil near the food base. Spores produced by fruiting bodies are not an important source of new infections or long distance spread.

TREE IMPROVEMENT SITE

Adjacent to the station is a former tree improvement progeny test site that was established to examine the growth of many non-native trees in the climate of southern California. Several years ago a light thinning was performed in the plantation.

Two tree species were being affected by insects in the plantation. Many of the Cuyamaca cypress (Cupressus stephensonii) had top and branch killing, although none of the trees had died. Examination of the bole and branches uncovered boring by the cypress bark beetle, Phloeosinus cristatus, in the inner bark and cambium. Small groups (2 to 3 trees each) and individual Monterey x knobcone pine hybrids had been attacked and killed by pine engraver beetles, Ips sp.

Both species of bark beetles are weakly aggressive and exploit some predisposition or stress of trees to make successful attacks. Two factors probably predisposed both species of trees to attack. Although thinned a few years previous, the trees still did not appear to have enough growing space because of their number and size. Competition for moisture between trees and with grass was high. The second factor was limited available water. From January 1984 through March 1985 the Los Prietos Ranger Station received 39% of its normal precipitation. The limited available moisture would have aggravated the intertree competition, resulting in significant tree stress, low resin flow, and successful beetle attacks.

Biology Of Pine Engraver Beetles

Pine engraver beetles (Ips spp.) belong to the group of insects called "bark beetles" because members of this group spend their immature lives and most of their mature existence under the bark of trees. This concealed existence provides them a high degree of protection from natural enemies and environmental stresses, as well as making detection and control of these pests difficult. Various species of pines are the only trees attacked.

A tree's natural resistance to initial bark beetle attack is to flow resin into the small tunnel the beetle is attempting to bore through the bark. If the moisture supply available to the tree to form resin is impaired by drought, injury, or root disease, the tree's resistance to attack is reduced. Any beetle which successfully attacks a tree inoculates it with a xylem blocking fungus (blue stain) and starts to produce a chemical signal (pheromone) which attracts additional beetles to the tree. Attacks may be confined so that only the tops of trees are killed; or if enough beetles are attracted to the spot, the entire tree and neighboring trees can be overcome by rapid, mass attack.

Green host material, such as broken branches and tops or fresh slash, have no resistance to attack and provide easily invaded host material to breed up large populations of beetles in localized areas.

In the southern California climate, pine engraver beetles have several, probably about four, generations per year. There is only a short overwintering period of inactivity during the coldest part of the year. The beetles overwinter as adult beetles and survival is poor, such that the population levels reach their lowest ebb during this cold period. This overwintering characteristic provides the rationale for preventing problems by avoiding the production of green slash in the spring and early summer. Available green slash in the spring provides a perfect haven for pine engraver beetles to invade and rapidly increase in numbers resulting in large populations being present later in the year when the trees are stressed by the normal drought and heat of the summer climate.

Pine engraver beetle adults live and breed in tunnels excavated between the bark and wood of their hosts. Eggs are deposited in niches along the margin of these tunnels. The eggs hatch and the larvae subsist on the cambium and inner bark material. Gallery patterns and insect appearances can aid in recognition and identification. Outward evidence of infestation are only the small holes in the bark and brown dust ejected during tunnel excavation. Considerable experience is needed before acquiring any proficiency in detection, recognition, and diagnosis of pine engraver activity.

MANAGEMENT ALTERNATIVES

1. No Action. As long as the trees in this plantation are undergoing stress, there is a high probability of additional damage and mortality. Continuation of deficient precipitation will likely result in the same or higher levels of damage. If precipitation returns to more normal levels, then the amount of damage would decrease, but some damage can be expected to continue.

2. Thin. Thinning beyond what has already been accomplished would provide an excellent opportunity to prevent or limit further damage. The amount of inter-tree competition would be reduced and more soil moisture would be available to the residual trees. The actual desired stocking level would have to be determined for the site and to accomplish management objectives. Based on past experiences, it would be best not to enter the plantation until precipitation and soil moisture have returned to normal levels since disturbances during stress periods often aggravate damage caused by pine engravers.

If the stand were thinned, then the green slash produced must be treated to reduce the possibility of creating large populations of pine engravers in the slash and their subsequent attacking of residual trees following emergence. Direct treatment methods are discussed in Alternative 3 below. If direct treatment is not possible, then limiting thinning activities to mid-July through December would lessen the hazard.

3. Treat Green Slash. Moist, green slash is a breeding ground for insects that can emerge and attack surrounding green trees. This is especially true for pine engravers. Not only is thinning and logging slash a hazard, but so is

storm breakage, etc. Treatment of green slash early in the year prior to insect emergence can reduce the probability of attack of surrounding trees.

- a) Lop and scatter. Lop all material down to 3 inches in diameter. Buck all material greater than 3 inches in diameter into 18-24 inch lengths. Scatter all material in sunny openings. Do not pile until slash has dried out.
- b) Crush. Drive a tractor over the slash, breaking it up and sloughing off the bark. This will increase the rate of drying and reduce the adequacy of the habitat.
- c) Pile and burn. Destroy the inner bark and cambium of the slash by burning. This must be done while the slash is green and before the beetles emerge. Care must be taken to limit scorching of residual trees.
- d) Remove slash. Remove slash to an area several miles from any host trees.

4. Direct Control. Because of the limited size of the plantation and easy access, direct control of pine engraver beetles to suppress their population in trees which do become infested may be effective. This alternative has not been used against the cypress bark beetle and we have no experience with the effective suppression of this pest. Implementing this alternative will require early detection and quick treatment of infested trees. At least 3 to 4 detection surveys of each tree will be necessary each year. These should be at one month intervals starting in May. Detection must be based on identifying boring dust, pitch streamers, and entrance holes since decline of the crown will not be immediate enough to identify infested trees before the beetles emerge. Once an infested tree is identified it must be effectively treated within 2 to 3 weeks to dispose of the beetles. Not following this schedule may result in not fulfilling the objective of protecting neighboring trees. Several treatment methods are available.

- a) Tree removal. Remove the boles and limbs down to 3 inches in diameter to an area several miles from any host trees.
- b) Burn trees. Fell infested trees and burn them sufficiently to consume the bark.
- c) Chemical spraying. The trees can be felled or left standing. The only chemical registered for treatment of infested trees is lindane. The entire bole and larger limbs must be thoroughly sprayed. All label requirements and restrictions must be followed and a Pesticide-Use Proposal must be approved by the Forest Supervisor.

OAK DECLINE

A concern of the Forest is the dieback of oaks, especially coast live oak, on the Forest and surrounding private lands. This is especially true for areas around Atascadero and along the Santa Ynez River. We examined two specific situations on the District: a large dying tree along Road 5N18 and declining oaks in campgrounds along this same road.

The large single coast live oak was next to the road at the junction with a driveway. Many of the branches in the crown had died. Chopping into the butt revealed that most of the cambium was dead and that subterranean termites were active in the wood. It appeared that past construction activities and the proximity to moving vehicles had resulted in numerous basal wounds. Decay and termites were able to enter these wounds and cause subsequent cambium mortality. This tree was dying from past physical abuse and was not representative of the general dieback in the area.

The oaks with dieback in the campground were more typical of the type of decline being experienced. Individual twigs were dying from the tip back and most were retaining their dead leaves. Observations in the field did not reveal any definite margin of cambium death, but a more diffuse area of browning. Neither was there any evidence of a twig canker in the form of any depressions or unusual growth patterns. These observations suggest that a microbial pathogen was not involved in the dieback. Subsequent isolations in the laboratory also did not reveal any such pathogens. Closer observations of twigs in the lab did reveal insect activity in the cambium. The insect discovered was the Pacific oak twig girdler, Agrilus angelicus. Most of the twigs examined had obvious larval mines of this insect.

The twig girdler is common on oaks, especially coast and interior live oaks, in southern California during periods of drought. Apparently the lack of moisture reduces the vigor of the tree sufficiently to permit active invasion by the insect. A similar situation occurred during the drought of the 1950's in southern California. At that time, the insect appeared to be more common in undeveloped areas, although it did attack significant numbers of residential trees.

Damaged twigs and leaves are usually retained 2 years or more by the tree. The insect has a 2 year life cycle, but new generations attack twigs each year. Past infestations do not appear to have caused any deleterious effects, other than visual, on infested trees.

No direct control actions have been developed against this insect. Improving the vigor of selected trees, principally those of concerned homeowners, may reduce damage. Activities such as watering and fertilizing should be beneficial. Surface watering is not effective and could cause problems from armillaria root disease. Deep watering that results in soil moisture penetrating 3 to 4 feet needs to be done every 2 to 3 months. Pruning dead and dying branches will improve the appearance of trees, but it will have limited effect on the insect.

Biology Of Pacific Oak Twig Girdler

The Pacific oak twig girdler, Agrilus angelicus, attacks a range of oak species, but it is especially important on live oaks in southern California. Trees weakened by drought are most affected. Affected trees have numerous patches of dead leaves throughout the crown. These dead patches are associated with the girdling of twigs by the insect.

The adult lays single, small, black eggs on the surface of twigs in the summer. Within 2 to 3 weeks the egg hatches and the larva bores into the twig. After entering the sapwood, the larva bores a linear mine toward the older twig

growth for 3 to 6 months. The larva then begins to mine spirally around the twig, girdling it. The following spring, leaves begin to turn brown. During the second summer, the larva continues boring into older tissue. This lasts until the larva is about 22 months old, killing more than a foot of the branch. The larva then turns back and mines in the center of the dead wood where it forms a pupal cell. Following pupation, the adult emerges, mates and begins a new generation. The entire life cycle takes 24 months and new generations are started each year.

In addition to dead branches with leaves attached, other reliable indicators of twig girdler attack include locating the spiral mining underneath the bark. Sometimes, these tunnels may be filled with dark brown, powder-like frass. The small whitish larva may also be discovered.